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Using the ANFIS and FDEA Approach in Modeling and Evaluating the Role of New Product Development on the Organization's Performance by Involving Resilience

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Abstract

Developing new products is considered strategic decision organizations take to achieve competitive criteria. Considering the nature of the New Product Development (NPD) process in an environment with limited resources, changing conditions with the possibility of unexpected disruptions, and the possibility of failure, the ability to adapt to changes with the help of organizational resilience is an idea studied in this paper. Also, the research hypotheses have been tested using the explanation of a conceptual model and structural equation modeling method. In the second phase, the effectiveness of the organizations under investigation is measured from the perspective of organizational resilience using the fuzzy data envelopment analysis method. Finally, the third phase of this paper examines the effects of resilience variables and the success of NPD on the performance of the new product and organizational performance by using adaptive neuro-fuzzy inference system. The results of this research indicate the existence of direct relationships between organizational resilience and the success components of NPD on the final performance of the organization. The data collection tool in this research is a questionnaire and the statistical population is the production companies accepted in the Tehran Stock Exchange Organization.

Keywords: New product development, Organizational resilience, New product performance, Organizational performance.

1 | Introduction

Today, we live in a world where human needs are changing daily. The ever-increasing speed of technological changes, the shortening of the product life cycle, and the increase in the competitive environment among

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product manufacturing companies have prompted them to conduct extensive research and actions regarding a concept called New Product Development (NPD) to maintain survival and sustainability in the competitive market. Although NPD is not known as a long-term action to achieve competitive advantages in the business market, it is necessary to do so due to changes in customer needs, increased competition in business, and the high speed of technological innovations. Today's organizations know that if they don't have appropriate responsiveness and flexibility about these changes, they will soon disappear; Therefore, they seek to create competitive advantages [1].

Despite the great importance of NPD, success in doing it is considered a significant challenge. Factors such as a company's limited resources and unexpected disruptions may hinder the success of NPD. Cooper and Edgett [2] stated that the world's failure rate of NPD projects is about 44%. The concept of success or failure of projects is formed based on the comparison between the company's main expectation and the product's actual performance in the market. The supply of new products is an essential feature in a successful business, and the ability to develop new products to compete in existing markets or new markets is the main feature of many leading companies. Therefore, understanding the factors affecting the success of NPD processes is very important for organizations.

Risk management is one of the most critical areas to ensure and control the success of a project. According to Imeni and Edalatpanah [3], when things are unclear, it is crucial to have a robust risk management strategy in place. In times of crisis, risk management enables businesses to remain adaptable and robust while avoiding any hurried or erroneous action. Despite this, there is little knowledge about how resilience is related to risk management. Therefore, businesses with sufficient resilience and risk management knowledge can be expected to protect their shareholders and customers against an unplanned disruption. Firms can deal with sustainable development and risk management using the concepts of resilience, robustness, and antifragility. Also, Huber et al. [4] defined organizational resilience as the inherent capacity of an organization to face unexpected events. Therefore, since avoiding all the risks and threats of a system is impossible, organizational resilience is recognized as a necessary safety measure in the industry.

According to Burnard et al. [5], the mechanisms that help create organizational resilience are improving situational awareness, reducing organizational vulnerabilities and systematic risks, and restoring efficiency after a disruption. Therefore, resilience is not only a response to disturbances but also the ability of a system to adjust its performance in expected and unexpected conditions. It, in turn, leads to broader organizational dynamic capabilities that support the system's capacity to adapt to new environmental conditions and improve other aspects of performance, such as quality and delivery.

This paper identifies the criteria and indicators affecting the success of NPD and organizational resilience that play a role in this field. In the following, by designing a standard questionnaire, data has been collected among the companies admitted to the stock exchange that have had a NPD project in recent years (The Tehran Stock Exchange is an organized and self-regulating market where brokers or traders trade securities according to the law. The stock exchange is established and managed as a public joint-stock company.) These companies were chosen for the study because market conditions, government, external factors, etc, highly influence these companies. Therefore, the risk in these companies is high, and concepts like resilience can help them. In the continuation of the research, with the help of the SEM, the data of the questionnaire is confirmed, and the efficiency of these companies in the field of resilience is measured by the FDEA method; finally, the performance of the organizations under investigation is determined by using the ANFIS method. Therefore, the research questions include the following:

I. What are the indicators affecting the success of NPD?

II. Which indicators of organizational resilience are effective on the success of NPD?

III. To what extent will the integration of organizational resilience indicators with the success of NPD positively affect product and company performance?

IV. To what extent will the performance of the new product have a positive effect on improving the performance of the organization?

2 | Literature Review

2.1 | Definitions and Keywords

In this section, definitions and explanations related to the keywords of this research are mentioned.

2.1.1 | New product development

The NPD process is considered a solution for creating opportunities for growth and competitiveness. In the Product Development Management Handbook [1], the NPD process is defined as a set of well-defined and systematic tasks, steps, and actions that describe the natural goal of a company to transform early immature ideas into marketable products and services.

2.1.2 | New product performance

New product performance is considered as the degree to which the new product achieves market share, sales growth, customer usage, and profit goals [6]. Therefore, organizations seek to create a competitive advantage by exploiting their tangible and intangible resources and trying to improve the performance of their new product.

2.1.3 | Organizational resilience

Organizational resilience is defined by standard BS 65000 as: "the ability of an organization to anticipate, prepare for, respond and adapt to incremental change and sudden disruptions to survive and prosper". It reaches beyond risk management towards a more holistic view of business health and success. A resilient organization is one that not merely survives over the long term but also thrives- ready for the future [7].

2.1.4 | Organizational performance

The organizational performance involves analyzing a company's performance against its objectives and goals. In other words, organizational performance comprises real results or outputs compared with intended outputs. Having a performance measurement system allows organizations to evaluate how the work is done in terms of cost, quality, and time, pay attention to the parts that need improvement, and work towards improving and improving the organization's future performance [8].

2.2 | Review of Recent Research

Cooper and Kleinschmidt [9] proposed a multi-step system for the NPD process in which the minor details in each of the processes of this model are examined and defined. In other words, Cooper's model is an operationalized roadmap for the NPD from idea generation to commercialization. Also, in another paper, according to a broad sampling of 161 companies in Europe and North America, he stated factors such as high quality, relevant strategy for the company, having enough resources for new products, senior management's commitment to new products, and entrepreneurial atmosphere. Montoya-Weiss and Calantone [10] stated that product performance measurement variables are divided into three broad categories of new product performance indicators: Financial, market share, and technical goals. According to him, financial and market goals can also be considered as dimensions of business performance.

A systematic approach to evaluate the development process of new products and analyze the product's performance after commercialization and release to the market is essential in today's competitive environment. The three main factors for the success of NPD are process, strategy, and resources. A quality product development process has the highest impact on the performance of new products. Multiple criteria usually measure new product performance, but a generally understood theme from studies is that new product performance includes productivity, effectiveness, and innovation [11]. Also, Huber et al. [4] presented the

results of a safety audit related to resilience engineering in a chemical company. According to the obtained results, the improvement of safety performance is based on the organization's dynamic capacity to reflect and change risk patterns. According to this research, resilience engineering focuses on how to help people cope with complexities under challenging situations. De Brentani et al. [12] showed that based on the new product data of 432 companies in America and Europe, company resources are an influential factor in competitive advantages. As a result of this advantage, the company's superior performance is possible through strategic plans. Also, Dinh et al. [13] proposed principles and factors that contribute to the flexibility of a process. These principles, which have been identified based on experts' opinions and literature review, are six principles, including flexibility, controllability, early detection, minimizing failure, limiting effects, control and implementation methods, and five main factors, including design, potential Diagnosis, emergency response plan, human factors, and safety management.

Akgün and Keskin [14] empirically investigated the role of variables related to organizational flexibility capacity on product innovation and company performance. Studying 112 companies found that the correct orientation and principled agility positively correlate with the company's product innovation. Also, Chen et al. [15] studied the relationship between team autonomy and NPD performance at different market turbulence levels. They measured the financial performance of NPD based on sales, profit, rate of return on investment, market share, and general expectations of managers. Nazari-Shirkouhi et al. [16] introduced the most essential aspect of new product design to identify customer needs. They used 16 fuzzy regression models to understand the relationship between customer satisfaction and new product design. Also, Azadeh et al. [17] investigated the performance of an aluminum manufacturing plant using integrated resilience engineering. This research shows that self-organization, reporting culture, flexibility, and training significantly impact the organization's performance.

Galli [18] studied risk and how to manage it during NPD projects. He proposed an approach to risk management systems as well as their management requirements. According to the research, the project management team should seek to develop a comprehensive risk management plan with the help of identifying and understanding the basic structure of risk management. Also, Kampianakis et al. [19] suggested using Artificial Neural Networks (ANN) for data mining to influence the efforts of the risk management group in NPD projects and its ability to predict the revenues of the investigated project. Morgan et al. [20] in research defined new product performance as the perceived degree to which the new product achieves its market share, sales growth, customer usage, and profit goals. This scale measures management's perspective on how new products meet overall performance, sales, market share, and customer usage goals. Also, in a similar study, Najafi-Tavani et al. [21] looked at the effect of joint innovation networks on new product performance. They measured the new product performance by considering the criteria of sales growth, market share, return on investment, customer acceptance and satisfaction, and development costs.

Melián-Alzola et al. [22] investigated organizational resilience in hotels. This paper proposes a holistic model to measure organizational resilience. To that end, it aims to analyze organizational resilience's determinants, i.e., resilience predictors (strategy and change), and assess how they contribute to hotel resilience and performance. Also, Ozanne et al. [23] investigated the effect of Social Capital (SC) and dynamic capabilities on organizational resilience in research. SC is a key resource that SMEs can mobilize to tap the resources embedded in internal and external relationships to respond to disruptions. Yet, the mechanism through which SC facilitates organizational resilience is not precise. Mathrani and Ibrahim [24] talked about the impact of cultural strategies in their study of New Zealand (NZ) on NPD. This paper examines the current NZ strategies for cultural inclusion in product development of different-sized companies that supply locally and globally through three case studies and compares the findings with theoretical models used in other regions. Also, Mao et al. [25] addressed the relationship between slack resources and organizational resilience with the moderating role of dual learning. The findings show that both absorbed and unabsorbed slack resources promote organizational resilience.

Edalatpanah [26] developed a DEA model with triangular fuzzy numbers in his paper. These fuzzy numbers are used in Decision-Making Unit (DMU) inputs and outputs. In addition, a new ranking function considering the interaction between membership and non-membership values of different intuitionistic fuzzy sets is defined. Also, Rezaei and Qiong [27] researched resilient suppliers in a paper. According to him, the design of the supply chain network and the selection of a resilient supplier play an essential role in managing the supply chain risk to deal with various operational risks and disruptions. *Table 1* also provides a summary of previous works related to this research. As can be seen, the difference between this paper and the work done can be identified.

Table 1. A brief review of the most related research.

Study	NPD	NPP	OR	OP	Real Case
Cooper [1]	✓				✓
Montoya-Weiss and Calantone [10]				✓	✓
Johanson et al. [11]	✓	✓			
Huber et al. [4]				✓	✓
De Brentani et al. [12]			✓	✓	✓
Dinh et al. [13]				✓	✓
Akgün and Keskin [14]			✓	✓	✓
Chen et al. [15]	✓			✓	✓
Nazari-Shirkouhi et al. [16]	✓				✓
Azadeh et al. [17]			✓	✓	✓
Galli [18]	✓		✓		✓
Kampianakis [19]	✓				✓
Morgan et al. [20]	✓	✓		✓	✓
Najafi-Tavani et al. [21]	✓			✓	✓
Melián-Alzola et al. [22]		✓	✓		✓
Ozanne et al. [23]	✓		✓	✓	
Mathrani abd Ibrahim [24]	✓	✓		✓	✓
Mao et al. [25]		✓	✓		✓
This Study	✓	✓	✓	✓	✓

In this research, an attempt has been made to examine the effect of success criteria in NPD and organizational resilience in an integrated manner on the performance of the new product and, ultimately, the organization's performance. Of course, there have been many studies on the effect of the success factors of NPD and new product performance, as well as the impact of organizational resilience on the performance of the organization separately in the subject literature of these concepts, but the integrated examination of these concepts on the new product performance and organizational performance is considered the innovation of this research. Also, in *Fig. 1*, the conceptual model of this research is presented according to the variables defined and explained above.

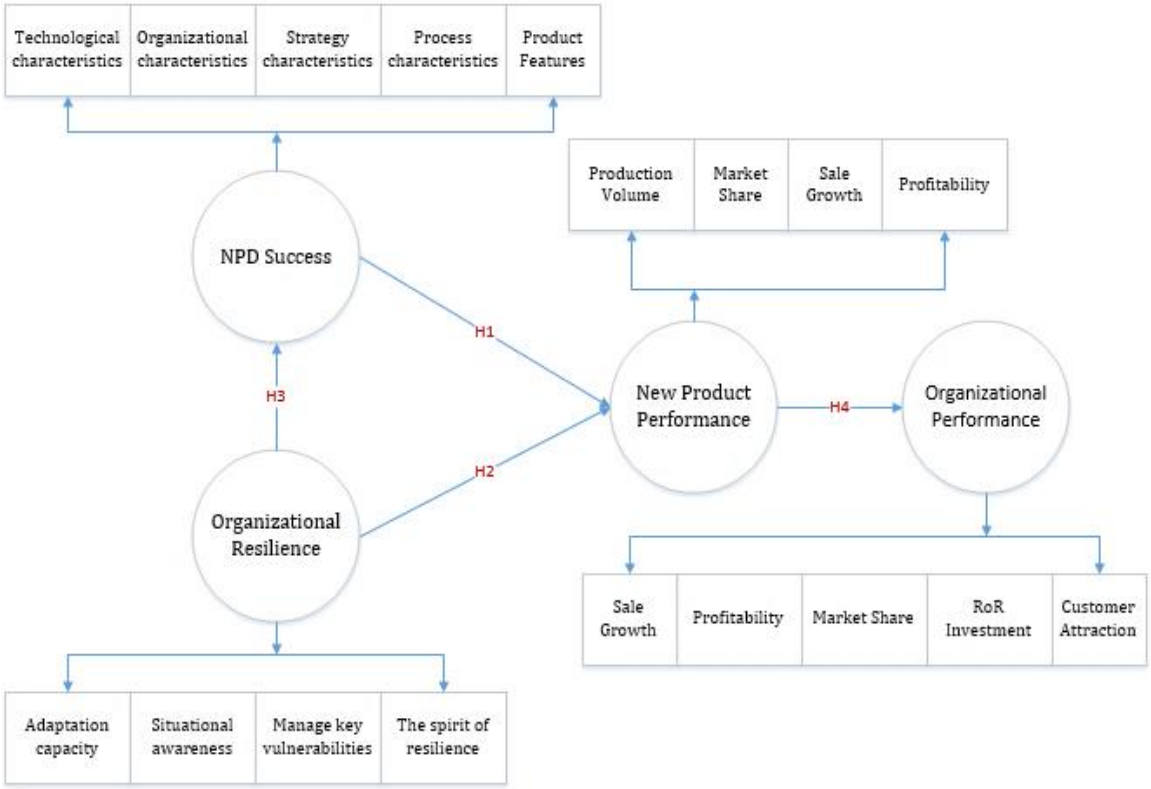

Fig. 1. Research conceptual model.

3 | Research Methodology

The method used in this paper is divided into three main phases. The first phase involves identifying the dimensions of each research variable, including NPD success, organizational resilience, new product performance, and organizational performance. Also, the questionnaire is prepared based on the above factors and the conceptual model of this research is analyzed using the method of SEM. In the second phase, the performance of the organizations under review regarding resilience is evaluated using the FDEA method. Finally, in the third phase, the ANFIS approach is used to predict the performance of the organizations studied in this paper. These steps are shown schematically in *Fig. 2*.

3.1 | Questionnaire Design

This research used a questionnaire to measure indicators and collect data. Based on the objectives and nature of the study, the questionnaire questions are rated in five options and based on the Likert scale as 5 completely agree, 4 agree, 3 abstain, 2 against, and 1 against. In addition to general questions related to the respondents, this questionnaire includes specific questions, including organizational performance with 5 questions [28], new product performance with 4 questions [29], NPD success with 20 questions [30], and 22 questions to evaluate organizational resilience [31]. Also, according to the statistical population of this research, 105 questionnaires have been distributed among the considered companies.

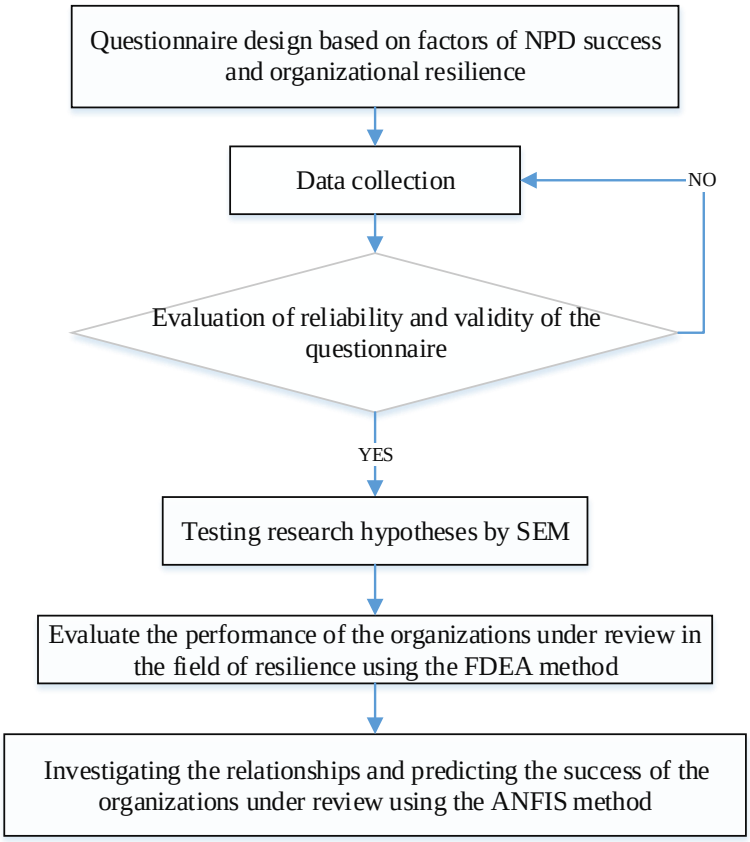

Fig. 2. Research methodology.

3.2 | Structural Equation Modeling

SEM is a multivariate statistical analysis technique used to analyze structural relationships. This technique is a combination of factor analysis and multiple regression analysis, and it is used to analyze the structural relationship between measured variables and latent constructs. As mentioned, in the first phase of this research, with the help of SEM, the dimensions of the research variables are identified, and the research model is evaluated.

3.3 | Fuzzy Data Envelopment Analysis

FDEA is a tool for evaluating the performance and productivity of companies or organizations operating under environmental uncertainty. Also, it is a nonparametric method to assess the relative efficiency of DMUs. FDEA uses the concept of fuzzy set theory to represent indeterminate data and analyzes this data with the approach of DEA, developed by Charnes et al. [32].

Therefore, in this paper, we use the FDEA method to determine the effect of organizational resilience in NPD projects. For this purpose, first, the scores of the questionnaire items related to each of the organizational resilience characteristics have been converted into a fuzzy data set. Then, the FDEA method has been used to measure total resilience. The DEA model developed by Banker et al. [33], named BCC, could be utilized to analyze the relative efficiency of DMUs under the assumption of variable returns to scale.

3.4 | Adaptive Network-Based Fuzzy Inference System

Neuro-fuzzy modeling [34] applies various learning techniques developed in the neural network literature to fuzzy modeling or a fuzzy inference system. The neuro-fuzzy system, which combines neural networks and fuzzy logic, has recently gained considerable interest in research and application. The neuro-fuzzy approach

added the advantage of reduced training time due to its smaller dimensions and the fact that the network can be initialized with parameters relating to the problem domain.

A specific approach in neuro-fuzzy development is the ANFIS, which has yielded significant results in modeling nonlinear functions [35]. In this study, the input variables in the ANFIS are the components of the new product and the total organizational resilience scores obtained by solving the FDEA method. The output variables are the scores obtained for the organization's performance and the new product's performance using the SEM method.

4 | Computational Results and Discussion

In this section, the computational results of this research are given. These results are based on the data obtained from the questionnaire. Also, the output results are obtained based on SmartPLS software. This section consists of 4 parts, each of which will be analyzed in detail below.

4.1 | Reliability and Validity of Questionnaire

As briefly discussed in Section 3.2, it is necessary to evaluate the validity and reliability of the questionnaire to obtain correct results.

4.1.1 | Reliability of questionnaire

In this research, Cronbach's alpha method is used to determine the reliability of the questionnaire. This method calculates the internal consistency of measurement tools, including questionnaires. The acceptable limit of Cronbach's alpha for practical purposes is at least 0.7. Recently, in addition to Cronbach's alpha criterion, the composite reliability criterion is also used [36]. Therefore, both criteria are used to measure reliability in the PLS method better. If the composite reliability value for each construct is above 0.7, it indicates appropriate internal stability for the measurement model. *Table 2* shows the relevant results.

Table 2. Cronbach's alpha and composite reliability values (third-order factor analysis).

Variables	Cronbach's Alpha	CR
Organizational reliance	0.962	0.964
NPD success	0.923	0.932

4.1.2 | Validity of questionnaire

Validity means to what extent the method used can correctly measure the characteristics determined by the research objectives. The questionnaire has convergent validity if the correlation between the scores of tests that measure a single trait is high. For this purpose, the Average Variance Extracted (AVE) should be calculated above 0.5. *Table 3* shows the relevant results.

Table 3. Convergent validity study (third-order confirmatory factor analysis).

Variables	AVE
Organizational reliance	0.649
NPD success	0.679

4.2 | Structural Model and Investigation of Research Hypotheses

After confirming the factorial structure of the research constructs, the SEM method is used to investigate the relationships between the variables. The SEM can be analyzed using SmartPLS software. Using the SEM, the relationships between the latent and observed variables can be examined. In the following, the results of the research hypotheses are presented based on the output of the SEM. *Table 4* shows the results of the research

hypothesis. Path coefficients and t-statistic values are used in this table. The path coefficient is the same as the beta coefficient in regression analysis, a number between -1 and +1 that indicates a direct or inverse relationship between two variables. Also, at the significance level of 95%, if the t-test values are more significant than 1.96, it confirms the corresponding hypothesis. Also, in *Fig. 3* and *4*, the structural model of the research is presented along with factor loadings and significant coefficients. As can be seen from *Table 4*, all research hypotheses have been confirmed.

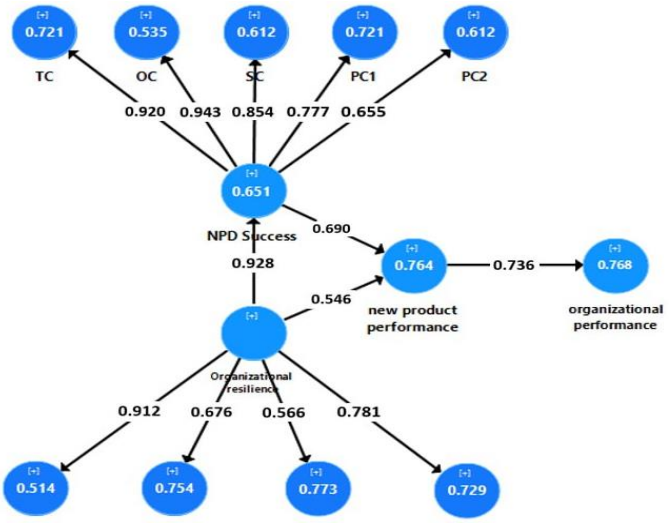

Fig. 3. Structural model with significant coefficients.

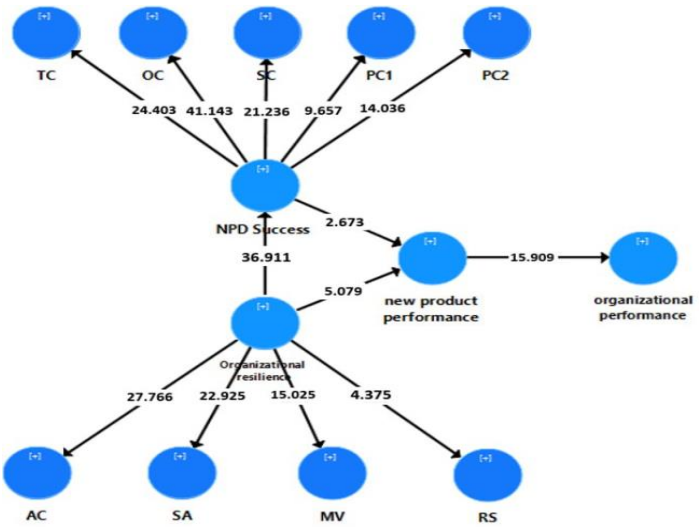

Fig. 4. Structural model with path coefficients.

Table 4. Analysis of model hypotheses.

Hypotheses	Path Coefficient	T-Value	Result
H1: The relationship between NPD success and new product performance	0.690	2.673	Confirmation
H2: The relationship between organizational resilience and new product performance	0.546	5.079	Confirmation
H3: The relationship between organizational resilience and NPD success	0.928	36.911	Confirmation
H4: The relationship between new product performance and organizational performance	0.736	15.909	Confirmation

Next, the model's overall fit (GOF) is also calculated. This criterion was presented by Tenenhaus et al. [37] which is calculated from the *Eq. (1)*:

$$\text{GOF} = \sqrt{\text{Avg(Cummunalities)} \times \text{R}^2}. \quad (1)$$

Communalities indicate the average communal values of each structure, and R^2 is also the average value of the explained variance of the endogenous structures of the model. Wetzels et al. [38] introduced three values of 0.01, 0.25, and 0.36 as weak, medium, and strong for GOF. The value of GOF in our model is equal to 0.606, which indicates the appropriate fit of the model.

4.3 | Ranking of Organizations Based on the FDEA Model

In this section, 105 organizations under study based on the FDEA model received an efficiency value based on the criteria considered for the organizational resilience group and are ranked accordingly. These criteria include 22 items collected according to the questionnaire mentioned for 105 considered organizations. The FDEA model is of the type without input and 22 outputs, as shown in *Table 5*. Also, DMUs represent organizations. Another parameter in the FDEA model is the α-cut value. MATLAB software has solved The FDEA model for 11 values of α (from 0 to 1), and the efficiency value for each DMU is determined. In the FDEA model, there is always a conflict between two objective functions, including the maximum efficiency of DMUs, which in this study include 105 organizations, and the second objective function, the level of satisfaction of model constraints, which decreases with the increase of alpha.

Table 5. Providing the outputs considered in the FDEA model.

Number	Factor	Criterion
1	The spirit of resilience in the organization	Commitment to resilience
2		Communication network perspective
3	Managing key vulnerabilities	Roles and responsibilities
4		Analysis of risks and their consequences
5		Connection awareness
6		Recovery priorities
7		Monitor and report on the internal/external situation
8		Conscious decision making
9	Situational awareness	Planning strategies
10		Participate in exercises
11		Capacity of internal resources
12		Capacity of external resources
13		Enterprise connectivity
14	Adaptive capacity	Identify vulnerabilities
15		Employee participation
16		Silo mentality
17		Communication and relationships
18		Strategic vision
19		Information and knowledge
20		Leadership and management structures
21		Innovation and creativity
22		Reactive decision making

In other words, the amount (1-α) indicates the satisfaction of the restrictions, which we always aim to decrease. According to *Fig. 5*, which shows the average efficiency of organizations in terms of different α, we can get the best result for $\alpha = 0.1$.

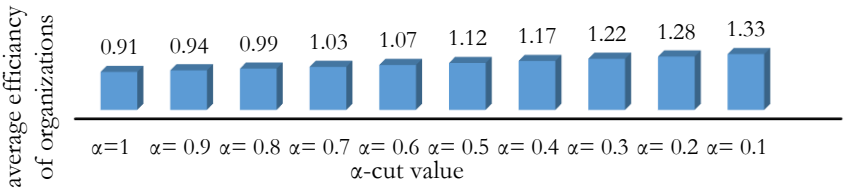

Fig. 5. Showing the average efficiency of organizations in terms of different α.

Therefore, the final ranking of the organizations under review based on $\alpha = 0.1$ is shown in *Table 6*. Due to the large number of organizations under review, we have mentioned only the first 10 companies in this table.

Table 6. Ranking of organizations based on an alpha value of 0.1.

Organization Number	Performance Scores	Ranking
28	1.5174	1
57	1.5174	1
58	1.5174	1
98	1.5174	1
102	1.5174	1
2	1.5038	6
34	1.5027	7
105	1.4992	8
83	1.4903	9
27	1.4896	10

4.4 | ANFIS Model Results

In this section, ANFIS modeling is done, and its results are presented. As mentioned in the previous sections, the inputs of the ANFIS model include "organizational efficiency" and "NPD success components" which were received from the questionnaire after conducting confirmatory factor analysis. Also, its outputs are "organization performance" and "new product performance", which are obtained from the output of PLS software. Also, the model error rate can be obtained based on *Eq. (2)* by considering the real outputs and model outputs.

$$\mathrm{MAPE} = \frac{\sum_{i=1,}^{\mathrm{size(TestTargets)}} \left| \mathrm{TestTargets(i)} - \mathrm{TestTargets(i)} \right/ \mathrm{TestTargets(i)} \Big|,}{\mathrm{Size(TestTargets).}} \qquad (2)$$

Notably, in the implementation of the ANFIS model, 80% of the data are considered training data, and 20% are considered test data. The ANFIS model is implemented in several stages, and during these implementations, the optimal model is selected based on the lowest MAPE value for the outputs. Also, the model was implemented using MATLAB software. According to *Eq. (2)*, the lowest MAPE value for the best model is shown in *Table 7*.

Table 7. MAPE for each output in the best ANFIS model.

Error rate	Output (1)	Output (2)
MAPE	0.11	0.14

In this way, the best ANFIS model is selected and the outputs of the model are obtained. The inputs and

outputs of the model are presented in *Table 8*. Of course, only the results for the first 10 companies are mentioned in this table.

The following determines the influence of each of the model's inputs on the outputs. The relationship between the organizational performance in terms of organizational resilience according to the ANFIS model is shown in *Fig. 6*. Also, the horizontal axis shows the organization's resilience, and the vertical axis shows the organization's performance. As it is clear from *Fig. 6*, there is a direct relationship between these two components, and the higher the level of resilience of the organization, the better the performance of the organization.

Table 8. Inputs and outputs of ANFIS model.

Organization	ANFIS Model Inputs		ANFIS Model Outputs	
	Organization Efficiency	NPD Success	Organizational Performance	New Product Performance
1	1.41	3.82	3.9054	3.7401
2	1.50	4.59	4.3844	4.2256
3	1.49	4.05	4.0852	3.9663
4	1.40	3.64	3.7973	3.6351
5	1.24	3.28	3.4806	3.2004
6	1.36	3.28	3.5783	3.4186
7	1.14	3.00	3.2546	2.9097
8	1.16	2.38	2.9475	2.6914
9	1.03	2.59	2.9516	2.5446
10	1.21	2.97	3.2958	3.0213

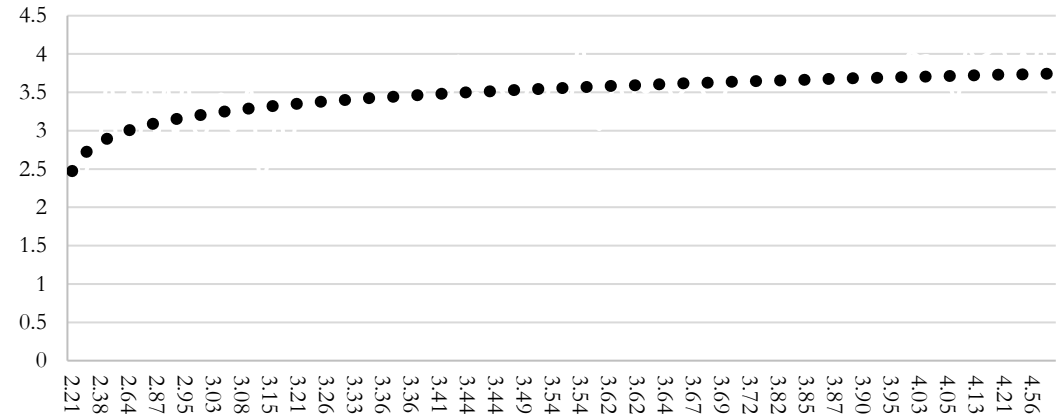

Fig. 6. The relationship between organizational resilience and organizational performance according to the ANFIS model.

The relationship between organizational resilience and new product performance is presented in *Fig. 7*. The horizontal axis shows the organization's resilience, and the vertical axis shows the performance of the new product. This chart's results indicate a direct relationship between organizational resilience and new product performance.

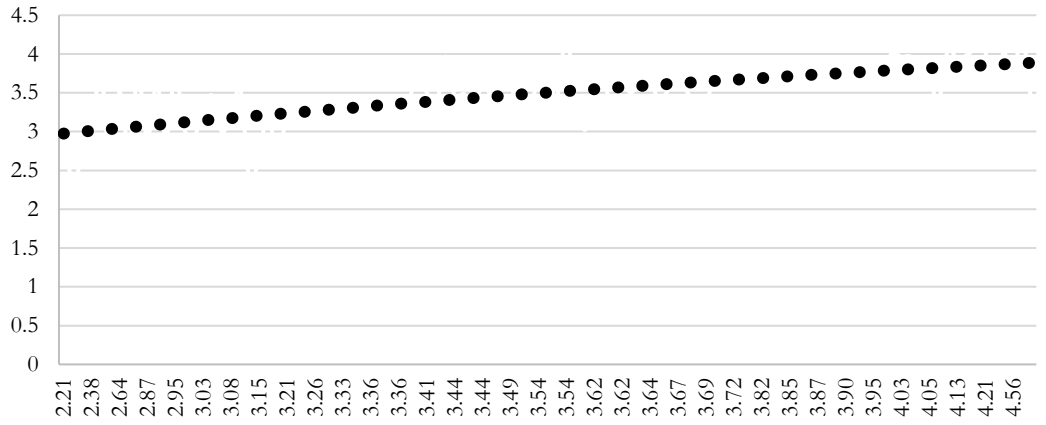

Fig. 7. The relationship between organizational resilience and new product performance according to the ANFIS model.

Next, the relationship between the NPD success and the performance of the investigated organization is shown in *Fig. 8*. The horizontal axis relates to the success components of NPD, and the vertical axis shows the organization's performance. Also, from this Figure, it is clear that there is a direct relationship between NPD success and organizational performance.

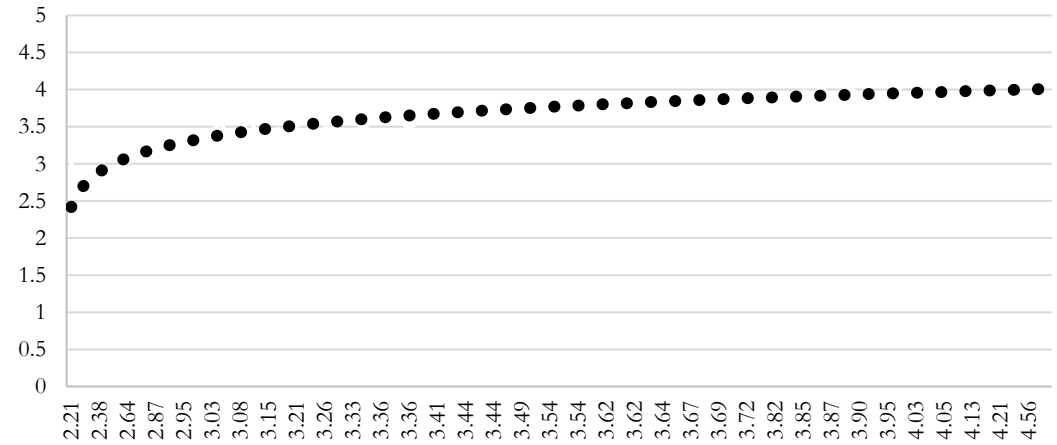

Fig. 8. The relationship between the NPD success and organization performance according to the ANFIS model.

The last case examines the relationship between NPD success and new product performance, presented in *Fig. 9*. The horizontal axis represents the success components of NPD, and the vertical axis represents the performance of the new product. The results indicate a direct relationship between the success components of NPD and new product performance.

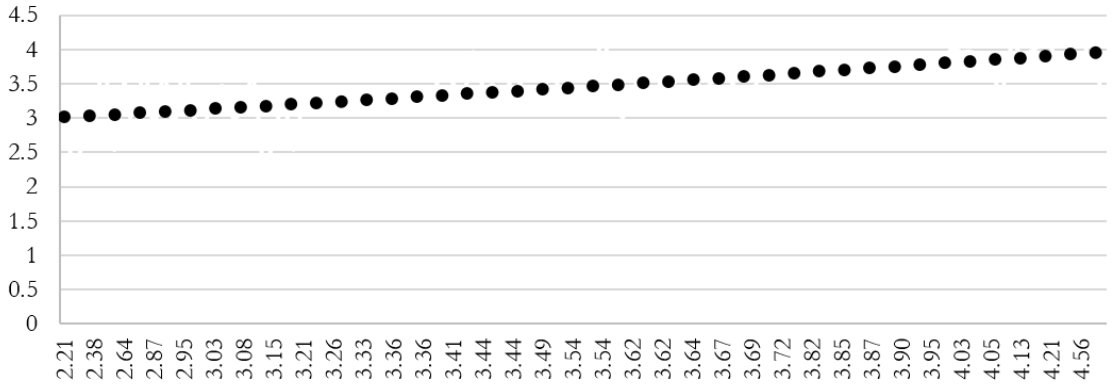

Fig. 9. The relationship between NPD success and new product performance according to the ANFIS model.

As a final result, *Table 9* shows the estimated correlation coefficient between the input and output of the model. As it is clear from the results of this table, there is a direct relationship between the inputs and outputs of the model. Also, since, according to the results, the efficiency of the organization, which is the output of the FDEA model and is introduced as a representative of the resilience index, has a significant impact on the organizational performance and the new product performance, it can be concluded that the resilience index is also in this sense, is very important.

Table 9. Estimated correlation coefficient between inputs and outputs in ANFIS model.

Input	Output	
	Organization Performance	New Product Performance
Organization efficiency	0.86	0.71
Components of NPD success	0.97	0.68

5 | Conclusion

The integrated implementation of the concept of organizational resilience and the success components of NPD projects can reduce the failure rate, increase the probability of success, and ultimately improve the organization's performance. Based on the obtained results, there is a direct and positive relationship between the NPD success and new product performance (t-value=2.67); This means that organizations can achieve success in new product projects by considering and trying to comply with these components. The results related to the research's first hypothesis align with the results of Montoya-Weiss and Calantone [10] and Sun and Wing [39].

Organizational resilience can be a safety measure to deal with risks and unexpected events during the NPD process. The results of this research indicate a positive and significant relationship between organizational resilience and new product performance and organizational performance (t-value=5.07). The results obtained in this field align with the results of Tarrant [40] and McCann et al. [41]. Also, the results indicate a positive and meaningful relationship between organizational resilience and the components of NPD (t-value=36.91). Therefore, organizations can improve the NPD process, improve the new product performance process, and finally provide a successful new product by applying the requirements to strengthen your organization. At the same time, many studies have been conducted in this field, all confirming this connection [42].

Finally, this research's results prove a positive and meaningful relationship between new product performance and organizational performance (t-value=15.90). Therefore, efforts to improve the performance of NPD projects as much as possible will lead to improvement in the organization's overall performance. The results obtained in this field are also in line with the research of Griffin and Page [43].

About the limitations affecting this research, we can mention things such as problems in preparing research data, non-cooperation of some production organizations to provide information due to contradictions with the policies of the organization, the bias of respondents in answering the questionnaire, or lack of familiarity of some respondents with the questionnaire variables. In addition, the results of this research are only limited to production organizations, while this concept can be extended to new service development processes. Therefore, such a study can be done for all fields, industries, and service organizations. It is also possible to use other variables, such as agility, topics related to the environment, and human resources, in the conceptual model of the research.

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Statements and Declarations

All the steps performed in this article are based on the principles of journal articles. This article is an extension of our research work during our PhD studies. Also, the authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

Conflicts of Interest

All co-authors have seen and agree with the manuscript's contents, and there is no financial interest to report. also, we certify that the submission is original work and is not under review at any other publication.

Author Contributions

Rahmat Arab: Conceptualization, Methodology, Software, Formal analysis, Investigation, Validation, writing–original draft, Writing – review & editing, visualization and monitoring.

Mohsen Forghani: Conceptualization, Methodology, Project administration, Data curation, resources, funding procurement, project management, Validation, visualization and monitoring.

Data Availability

The data that support the findings of this study are available from the corresponding author upon reasonable request.

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